EXHIBIT H

A Repeat Sales Index for Commercial Real Estate — Using Sold Properties in the NCREIF Database

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The NCREIF Property Index (NPI) has been calculated quarterly since 1978, using the appraised values of the properties in the database each quarter. When a property is sold, the sale price is used instead of the appraised value during the final quarter that the property is in the database. During all the quarters prior to sale of the property, the used appraised value is reported by the manager. Although the appraised value is reported quarterly, it is well known that many of the properties are not actually reappraised each quarter. This is one of the reasons that the NPI suffers from "appraisal smoothing," as has been discussed in numerous articles in *Real Estate Finance*. Since the inception of the NPI, more than 3,000 properties have been sold. For these sold properties, we can calculate an index using the repeat sales methodology commonly used for residential real estate indices.[1] This methodology was extended to total returns for commercial real estate by David Geltner and Will Goetzmann[2] with the NCREIF database, using only reappraisals of the property in what might be termed a "repeat reappraisal index."[3] This addresses the problem of "stale" appraisals in the NPI resulting from properties not being reappraised each quarter. But the index is still an appraisal-based index and may still suffer from smoothing owing to the nature of the appraisal process itself, which relies to some extent on older information because of inefficiencies in the real estate market. Jeff Fisher and David Geltner[4] recently extended the repeat reappraisal index methodology to in effect adjust the appraised values for the empirical lag between the sale price and contemporaneous appraised value for properties sold from the NPI. This is one approach that allows better use of sold property information in the NCREIF database to address appraisal smoothing.[5] This article takes a different approach by using *only* information from sold properties. The repeat sales methodology is applied using the sale price of the property and the value reported when the property first enters the NCRIEF Index. Only interim cash flows (NOI, capital expenditures, and partial sales) are used during the interim years until the property is sold. The effect of appraisals is therefore virtually removed from the calculation of this Repeat Sales Index (RSI).[6]

DATA

The data used to estimate RSI are based on sold properties from the NCREIF database. Some sold properties were eliminated because they were not "true sales" (there was a change of manager, they burned down, etc.) or were not representative of core real estate (hotels, development projects, properties purchased for immediate resale within a year, etc.). The specific criteria used to filter out certain sales are described in the methodology section that

EXHIBIT 1
Annual Sold Properties by Property Type

Year	Apartment	Retail	Office	Industrial	Total
1978		1		2	3
1979	1			1	2
1980				3	3
1981			1	2	3
1982		6	3	10	19
1983	1	10	7	23	41
1984		15	22	29	66
1985	2	15	21	49	87
1986	2	24	28	49	103
1987	1	17	23	43	84
1988	9	22	21	66	118
1989	5	19	47	65	136
1990	5	13	34	49	101
1991	5	6	34	48	93
1992	9	18	20	35	82
1993	39	15	39	40	133
1994	36	23	36	73	168
1995	30	30	47	55	162
1996	57	59	96	114	326
1997	73	100	87	166	426
1998	64	86	104	106	360
1999	53	82	78	85	298
Total	**392**	**561**	**748**	**1,113**	**2,814**

EXHIBIT 2
Aggregate Sale Price and Average Sale Price Each Year

Year	Aggregate Sale Price	Average Sale Price
1978	$4,800,031	$1,600,010
1979	36,736,767	18,368,384
1980	1,914,421	638,140
1981	3,452,980	1,150,993
1982	72,501,364	3,815,861
1983	170,064,085	4,147,905
1984	383,215,387	5,553,846
1985	424,119,939	5,049,047
1986	657,784,825	6,386,260
1987	732,769,133	8,723,442
1988	1,250,080,162	10,593,900
1989	1,379,766,598	10,220,493
1990	700,682,561	7,149,822
1991	967,397,331	10,077,056
1992	474,035,520	6,000,450
1993	1,153,229,521	8,417,734
1994	1,875,460,265	11,163,454
1995	2,136,606,284	13,188,928
1996	4,642,972,249	14,242,246
1997	9,030,320,372	21,197,935
1998	9,137,175,714	25,381,044
1999	6,835,381,942	22,937,523

follows. There were 2,814 properties remaining that were used to estimate the Repeat Sales Index. Exhibit 1 shows a breakdown of the number of sales of each property type each year. (The index was actually estimated using quarterly data. The sales are summarized in the table by year for brevity.) Exhibit 2 shows the aggregate value of all properties sold each year as well as the average value of the properties sold.

METHODOLOGY

We started with all properties that had been sold at some point in time from the beginning of the NCREIF Index in 1977 through the fourth quarter of 1999.[7] From this starting sample of all sold props, we eliminated certain sales that we did not deem appropriate for the Repeat Sales Index. First, we eliminated projects that had undergone significant renovations that included a "development profit" based on a cumulative capital expenditure over the holding period exceeding 75% of the property value. Second, we eliminated properties held for less than one year. These properties clearly do not represent purchases under a buy-and-hold strategy. We refer to them as "flips." Third, we eliminated hotels because they are not core real estate. Fourth, we eliminated properties with an absolute value of their IRR greater than 10% per quarter (more than 40% per year).[8] These unusually high or unusually low properties were removed under the assumption that they tended to represent either a significant change of use over the holding period that led to a very high IRR or an environmentally contaminated property leading to a very low IRR. Last, some properties were not included that came into the database the very first quarter the NPI started. Based on an analysis of the residuals after running the Repeat Sales Index the first time, it was obvious that the initial value of these properties caused them to be outliers. These tended to be properties that were not actually purchased when the index started but were already held by the manager and probably had not had an external appraisal done just to include them in the index for the first time.

EXHIBIT 3

Equal-weighted Repeat Sales Index versus Sold Properties NPI

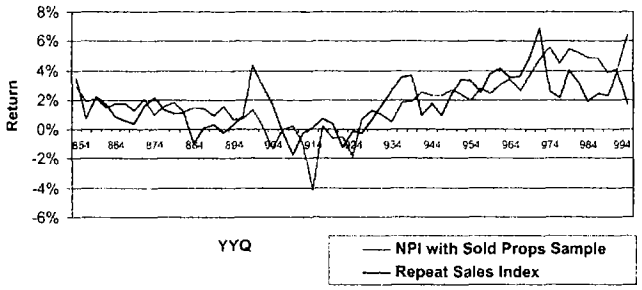
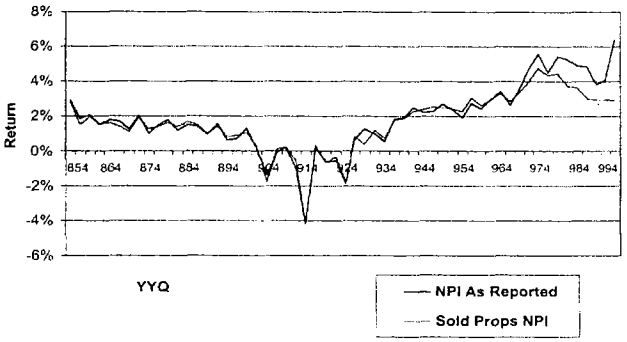


EXHIBIT 4

NPI for sold Props Sample versus NPI Using All Props



Because the purpose of this index is to capture the actual purchase price, these properties were eliminated.

After the previously mentioned sold properties were eliminated, there were 2,814 remaining that were used to estimate the RSI. The repeat sales methodology described earlier was applied to these sold properties. An instrumental variables regression was used as was done by David Geltner and Will Goetzmann[9] because of uncertainty in measuring the cash flow variables. We also used the ridge regression technique first suggested for real estate repeat sales indices by Will Goetzmann[10] to filter noise that is greatest in the quarters when there are a relatively few number of sales.[11] This technique has since been refined for application to commercial property in a couple of RERI-sponsored studies.[12]

The index is estimated using two weighting procedures. One approach is to value-weight each property in a way that is analogous to the way the NPI is calculated.[13] The other approach is to normalize the resale price and interim cash flows by dividing by the initial purchase price. This in effect provides an equal-weighted index; i.e., each property is given the same weight. The choice depends on whether the properties used are considered a population of properties or a sample of properties from the NCREIF database. The latter interpretation (a sample) is probably more appropriate when using only sold properties from the NCREIF database. However, we also calculate it on a value-weighted basis, for two reasons: first, to compare it with the value-weighted NPI and second, to include it with the IPC fund-level database, as described in the companion article in this issue of *Real Estate Finance,* by Mike Miles, David Guilkey, and Jeffrey Fisher.

RESULTS

Exhibit 3 shows the results of the equal-weighted Repeat Sales Index as compared to an appraisal-based index that uses the same sold properties from the NPI. The sold properties NPI in the graph is based on the traditional way of calculating the NPI, i.e., using the quarterly appraised value until the property is sold. It differs from the regular NPI in that it is based on the subset of sold properties and is equal weighted instead of value weighted to compare with the equal-weighted RSI. As expected, the RSI has more volatility and tends to lead the NPI when there are major shifts in the market. For example, it turned negative before the NPI in the 1980s and started to turn positive before the increase in the NPI in the early 1990s. It also peaked in 3Q in 1997, whereas the NPI tried to peak in 4Q in 1997 and 1Q in 1998. Although we shouldn't try to read too much into specific quarterly turns based on this sample of data, it should be clear that there is a lot we can learn from repeat sales indices.

Exhibit 4 shows a comparison of the NPI for the sold properties sample with the traditional NPI, which includes all properties (sold or unsold). They are obviously very similar and only depart during the later quarters in the 1990s, when the number of properties remaining in the sold property sample used to calculate the sold properties NPI is very small (since most properties have been sold by then). Thus differences in the composition of the sold properties (property type and location) versus those properties in the NPI become more dramatic.

Exhibit 5 compares the equal-weighted RSI with the NAREIT Index. Note that the scale for the NAREIT

EXHIBIT 5
Equal-weighted Repeat Sales Index versus NAREIT

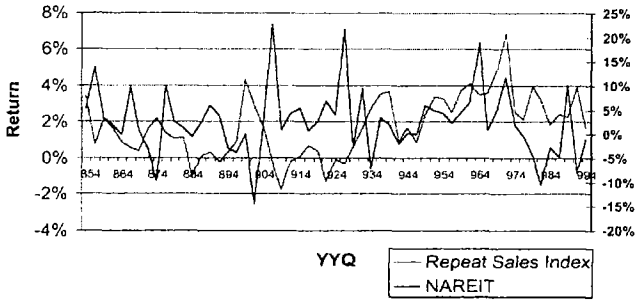


EXHIBIT 6
Equal-weighted versus Value-weighted RSI

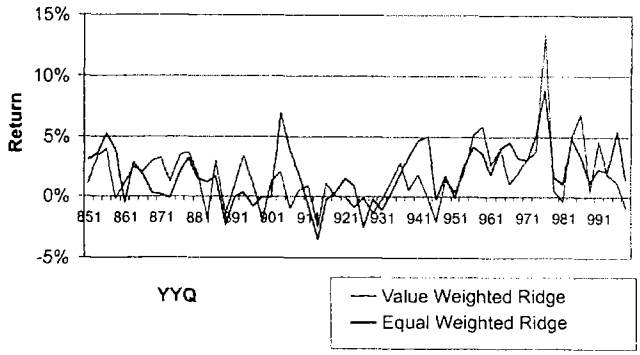


EXHIBIT 7
Ridge versus Moving Average for Value-weighted RSI

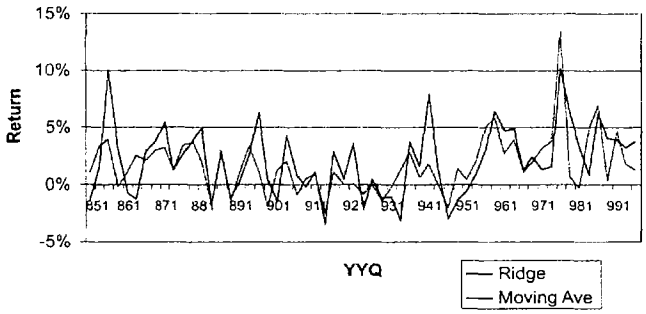
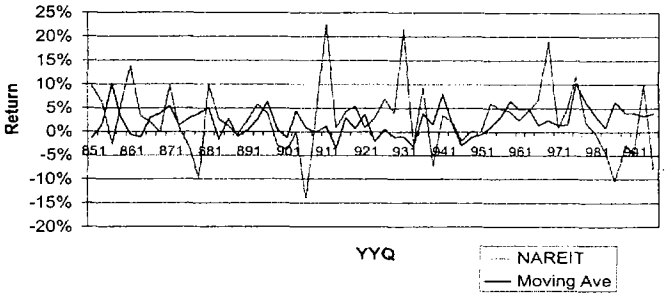


EXHIBIT 8
Value-weighted RSI Moving Average versus NAREIT



Index (right-hand side) has a greater range because the stock indices have higher volatilities than even a transaction-based private real estate index. Because any effect of appraisal smoothing has been removed from the RSI, the difference should be attributable to the higher variance of REITs that trade in a more liquid and informationally efficient market.[14]

Exhibit 6 shows a comparison of the equal-weighted versus the value-weighted RSI. As mentioned earlier, the regular NPI is value weighted. The differences are due to the performance of larger versus smaller valued properties over different time periods.

The RSI shown in the previous exhibits used the ridge regression to remove noise in quarters when there are fewer observations (fewer sales). An alternative approach that is perhaps less elegant but more understandable is to estimate the RSI without using a ridge in the regression but to calculate a four-quarter moving average of the returns.[15] This is illustrated in Exhibit 7. Note that the pattern is very similar in terms of both turns and peaks in the market as well as volatility.

Exhibit 8 compares the moving-average version of the RSI discussed previously with the NAREIT Index. In this exhibit the same scale is used for the RSI and NAREIT so that differences in volatility are more obvious. It is somewhat surprising that there are more similarities than might be expected for these two indices, since the RSI is private real estate and the NAREIT is publicly traded shares of stock, not to mention differences between the composition of the properties owned by REITs and the properties that happen to be sold from the NPI. During the late 1980s they track fairly closely, but

they depart dramatically during the early 1990s, when the volatility of REITS increases significantly. They then seem to start tracking again, especially during the mid-1990s (except for the blip in REITs in the fourth quarter of 1996). After they both peak at almost the same return of around 10% (quarterly) in the third quarter of 1997, there is again a departure when the REIT market falls significantly, whereas the private market holds up fairly well. Comparisons of these indices are clearly ripe for further research. Perhaps some of the similarities are due to REITs being the marginal purchasers of properties during periods like the mid-1990s, as opposed to the late 1990s, when they were not marginal investors.

CONCLUSION

It should be obvious from the results of this research that a reasonable index can be estimated using only repeat sales from sold properties. Because the composition of properties that sell (property type and geographic area) will not be the same as that of the NPI, it is not intended as a substitute for the traditional NPI. The sample size of sold properties is also not sufficient to estimate subindices by property type and geographic area, as is done for the NPI. But the index does provide interesting insights into the performance of commercial real estate and may tend to lead the NPI by at least a quarter. And it removes any effect of appraisal smoothing that is in the NPI. It also seems to take on more of the characteristics of the REIT market, as represented by the NAREIT index, than the traditional NPI. This may be attributed to the fact that both are based on *transactions*; i.e., the NAREIT index, is based on transactions of stock, and the RSI is based on transactions of properties. Also, the marginal buyers of properties during a significant part of the 1990s may have been REITs. As the NCREIF index expands and more information on sold properties is obtained, the reliability of pure transaction-based indices like the RSI should increase and may even ultimately replace appraisal-based indices. Furthermore, note that because the RSI does not require appraisals, properties could be contributed to an RSI-based index held by investors who do not conduct quarterly appraisals. This could even include development projects with cash investments over a development period. All that is needed for inclusion in the RSI are the cash flows flowing into and out of an investment from acquisition (or beginning of development) until disposition. Even land development projects with sell out of lots could conceivably be included. This opens up immense possibilities for the future of indices that could help us better understand the performance of commercial real estate.

ENDNOTES

[1]See Shiller [1991].

[2]See Geltner and Goetzmann [2000].

[3]NCREIF has coined this index the "Current Value Index," or CVI, because it uses only current values from reappraisals.

[4]Presented at the recent meeting of AREUEA. See Fisher and Geltner [1999].

[5]The authors refer to this as a "Transaction Value Index," or TVI, because it uses sales transactions to adjust the appraised values. Note, however, that this index does not rely solely on transactions.

[6]When the manager purchases the property, the initial value reported to NCREIF should be based on the purchase price of the property. There may be some cases where a property reported to NCREIF for the first time was not actually purchased that quarter. In these cases, the appraisal will not be based on a purchase price. Using the initial value when the property enters the NPI is the best proxy possible for a purchase price.

[7]The database as of the first quarter of 2000 was used. The sale price for properties sold anytime during the first quarter of 2000 replaces the appraised value for the fourth quarter of 1999; i.e., they are sold from the index at the end of the beginning of the partial quarter that they were sold.

[8]The IRR was calculated from purchase to sale for each property, including all interim cash flows.

[9]See Geltner and Goetzmann [2000].

[10]See Goetzmann [1992].

[11]The ridge regression gives more weight to the mean return during quarters when there are fewer observations of either the purchase or sale price.

[12]See Gatzlaff and Geltner [1998] and Geltner and Goetzmann [2000].

[13]In the repeat sales methodology, this involves using the actual dollar value of each property rather than a normalized value, as is done for equal-weighted returns.

[14]It is possible that the use of the ridge regression to smooth out the noise in the RSI has reduced the RSI volatility below the true volatility.

[15]The weightings are 35%, 30%, 20%, and 15% for periods t through t-3, respectively.

REFERENCES

Fisher, J., and David Geltner. "Quarterly Unsmoothing of the NCREIF Index without Assuming an Efficient Market." Working paper, University of Cincinnati and Indiana University, presented at the annual meeting of the American Real Estate and Urban Economics Association, Boston, January 2000.

Gatzlaff, D., and David Geltner. "A Transaction-Based Index of Commercial Property and Its Comparison to the NCREIF Index." *Real Estate Finance*, Vol. 15, No. 1 (Spring 1998), pp. 7-22.

Geltner, David. "The 1998 RERI Seminar and Research: Securitization and Real Estate Performance Measurement." *Real Estate Finance*, Vol. 15, No. 2 (Summer 1998), pp. 23-35.

——. "The Repeated-Measures Regression-Based Index: A Better Way to Construct Appraisal-Based Indexes of Commercial Property Value." *Real Estate Finance*, Vol. 12, No. 4 (Winter 1996), pp. 29-35.

——. "Using the NCREIF Index to Shed Light on What Really Happened to Asset Market Values in 1998: An Unsmoother's View of the Statistics." *Real Estate Finance*, Vol. 16, No. 1 (Spring 1999), pp. 69-80.

Geltner, David, and W. Goetzmann. "Two Decades of Commercial Property Returns: A Repeated-Measures Regression-Based Version of the NCREIF Index." *The Journal of Real Estate Finance & Economics*, Vol. 21, No. 1 (July 2000).

Goetzmann, W. "The Accuracy of Real Estate Indices: Repeat Sale Estimators." *The Journal of Real Estate Finance & Economics*, Vol. 5, No. 1 (March 1992), pp. 5-54.

Shiller, R. "Arithmetic Repeat Sale Price Estimators." *Journal of Housing Economics*, Vol. 1, No. 1 (March 1991), pp. 110-126.